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Question Paper Code : 40267

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Sixth Semester

Civil Engineering

CE 8001 — GROUND IMPROVEMENT TECHNIQUES

(Regulations 2007)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What are options to deal with the problematic geotechnical conditions?

2. A project site has a 5-m-thick loose gravel layer near ground surface that needs to be improved for foundation support. Which methods may be used for ground improvement? Why?

3. Define "double diffuse layer".

4. What are the general parameters required for design of dewatering?

5. Give the significance of 'smear zone'.

6. Define 'Equivalent Diameter' in stone column.

7. What are the different polymers used for geosynthetic manufacturing?

8. What are the different types of geotextiles?

9. What are the environmental control applications of jet grouting techniques?

10. What are the monitoring and acceptance tests for permeation grouting?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Explain about different methods of ground improvement techniques based on its functions and applications. (8)

(ii) Explain about different factors considered for selection of ground improvement method. (5)

Or

(b) (i) Explain about the available ground improvement methods for different so types. (8)

(ii) Brief about the possible methods for shallow ground improvement techniques. (2.5)

(iii) Brief about the possible methods for deep ground improvement techniques. (2.5)

12. (a) (i) Brief about the typical applications of Electroosmosis. (4)

(ii) Explain the following dewatering techniques with neat sketch: (3 × 3 = 9)

(1) Well point system with components

(2) Sumps, Trenches and Pumps

(3) Deep wells with submersible pumps.

Or

(b) (i) A job site requires an excavation of a rectangular area (220 m × 170 m) to a depth of 15m, as shown in Figure 12 (b) (i). The existing groundwater table is at 5m. Below the ground surface is 30 m thick gravel with a permeability of 5.0×10^{-5} m/s, which is underlain by bedrock. The groundwater table should be lowered to 1.5 m below the bottom of the excavation. Deep wells are used to dewater the site. Calculate the total required discharge. If 200 mm diameter deep wells are used, how many deep wells are required? (10)

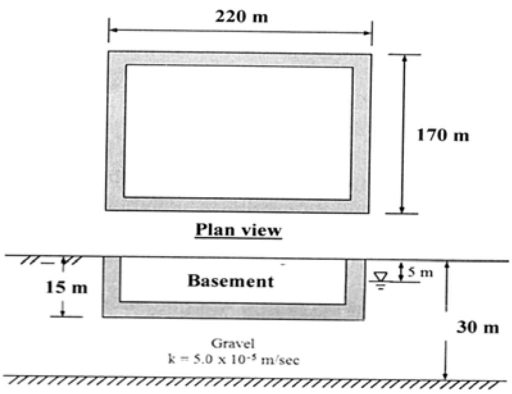

Figure 12 (b) (i)

(ii) What are the factors affecting the suitability of dewatering techniques? (3)

13. (a) (i) Discuss the main differences among dynamic densification, dynamic consolidation and dynamic replacement. (5)

(ii) Brief about the advantages and disadvantages of stone columns. (4)

(iii) Briefly explain with neat sketch, the possible failure modes of individual stone columns subjected to vertical loads. (4)

Or

(b) (i) A site consists of 20 m thick soft clay with an undrained shear strength of 20 kPa. The groundwater table is at a depth of 1.0 m. The unit weights of the soil above and below the groundwater table are 18 and 19 kN/m^3. A square footing with a width of 2.0 m will be constructed on this site with an embedment depth of 1.0 m. The applied load of this footing (including the weight of the footing) is 400 kN. The required factor of safety against bearing failure is 2.5. Granular columns of 10 m long are designed in an equilateral triangular pattern with column spacing of 1.5 m and column diameter of 0.8 m. Evaluate whether this design meets the bearing capacity requirement. (10)

(ii) What are the advantages and limitations of preloading techniques? (3)

14. (a) (i) What are the different categories of geosynthetics? And briefly explain about its application areas and functions. (5)

(ii) Explain with neat sketches the geosynthetics application in Landfills. Explain about the Landfill final cover and the liner system. (8)

Or

(b) (i) What are the different types of solid waste landfill geometry with neat sketches? (3)

(ii) Assume you are dealing with a 10 m high, 50° angle slope shown in Figure 14 (b) (ii), which consists of a silty clay embankment (γ = 19 kN/m^3, Φ = 0°, and c = 15 kPa, area = 60 m^2, center of gravity as indicated) on a silty clay foundation (γ = 20 kN/m^3, Φ = 0°, and c = 18 kPa, area = 55 m^2, center of gravity as indicated).

(1) Determine the factor of safety with no geotextile reinforcement.

(2) Determine the factor of safety with a geotextile of allowable tensile strength 40 kN/m (note that with a cumulative reduction factor of 3.0, this is an ultimate strength geotextile of 120 kN/m) placed along the surface between the foundation soil and the embankment soil.

(3) Determine the factor of safety with 12 layers of the same geotextile placed at equal intervals from the foundation interface to the top of the embankment. Assume that sufficient anchorage behind the slip circle shown is available to mobilize full -geotextile strength.

(4) How would the problem solutions differ if granular soil were involved? (10)

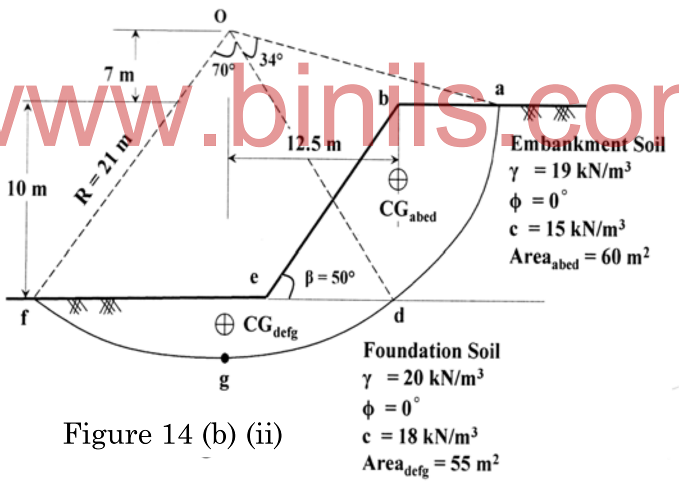

Figure 14 (b) (ii)

15. (a) (i) What are the advantages and limitations of Grouting techniques?(3)

(ii) Explain in detail with neat sketches the different types of grouting techniques and its construction stages. (10)

Or

(b) (i) Briefly explain with neat sketches the typical grouting components and its setup. (5)

(ii) Explain about the lime stabilization and the lime-soil reactions. (4)

(iii) What are the advantages of lime stabilization? (4)

PART C — (1 × 15 = 15 marks)

16. (a) Design a 8 m high wrap-around type of geotextile wall (Figure Q. 16 (a)) that is to carry a storage area of equivalent dead load of 15 kPa. The wall is to be backfilled with a granular soil (SP) having properties of $\gamma = 18$ kN/m^3, $\Phi = 36°$, and c = 0. A woven slit-film geotextile with warp (machine) direction ultimate wide-width tensile strength of 60 kN/m and friction angle with granular soil of $\delta = 24°$ is intended to be used in its construction. The orientation of the geotextile is perpendicular to the wall face and the edges are to be overlapped or sewn to handle the weft (cross machine) direction. A factor of safety of 1.4 is to be used along with site-specific reduction factors. (Check the internal and external stability of the retaining wall). (15)

Note : $RF_{ID} = 1.2$, $RF_{CR} = 2.5$, $RF_{CBD} = 1.26$, $N_C = 10.98$, $N_Y = 2.65$

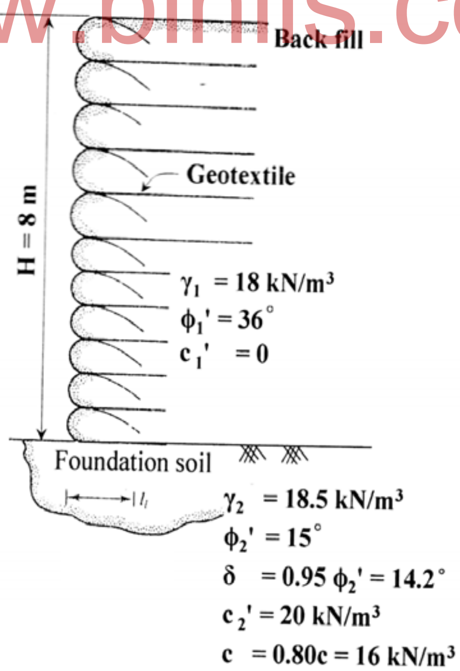

Figure Q. 16 (a)

Or

(b) (i) Briefly explain with neat sketches the possible modes of failures for the reinforced soil for a footing. (5)

(ii) Explain in detail with neat sketch the different stone column installation techniques. (5)

(iii) What are the design characteristics of filter materials? (2)

(iv) What are the factors influence the design of Dynamic Compaction? (3)